10/009750

10 Rec'd PCT/PTO 30 APR 2002

Docket No.: 43890-555

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	
Toyonori KANETAKA, et al.	:	
Serial No.: 10/009,750	:	Group Art Unit:
Filed: December 12, 2001	:	Examiner:

For: METHOD OF MANUFACTURING CHIP INDUCTOR

AMENDMENT

Commissioner for Patents
Washington, DC 20231

Sir:

Prior to examination on the merits, please amend the above-identified application as follows:

ABSTRACT

Please replace the existing abstract with the abstract attached hereto.

IN THE SPECIFICATION

Pursuant to 37 C.F.R. 1.125(b), Applicants submit herewith a substitute specification in order to improve grammar and syntax. The substitute specification does not include new matter. A marked-up copy showing changes is attached.

IN THE CLAIMS

Please amend claims 1-32 to read as follows:

1. A method of manufacturing a chip inductor comprising the steps of:

forming a conductive layer on an outer periphery of a substrate made of insulating material;

forming a coil by spirally cutting said conductive layer;

etching said coil;

forming an outer coating by coating at least said coil on said substrate with insulation resin; and

forming an electrode at both ends of said coil and making an electric contact between said electrode and said conductive layer,

wherein the step of forming an outer coating includes the step of using an electrodeposition method to deposit said insulation resin at least on a surface of a conductor of said coil.

2. The method of manufacturing a chip inductor according to claim 1, further comprising the steps of heating and curing said insulation resin, after using said electrodeposition method.

3. The method of manufacturing a chip inductor according to claim 2, further comprising the step of cleaning prior to the step of heating.

4. The method of manufacturing a chip inductor according to claim 2, wherein the step of heating comprises a first heating process for heating said insulation resin at a temperature lower than a

curing temperature of said insulation resin, and a second heating process for heating said insulation resin thereafter at a temperature higher than the curing temperature of said insulation resin.

5. The method of manufacturing a chip inductor according to claim 2, wherein the step of heating comprises a heating and filling process for heating said insulation resin at a temperature lower than a curing temperature of said insulation resin for filling a groove in said coil portion with said insulation resin, and a second heating process for heating said insulation resin at a temperature higher than the curing temperature of said insulation resin for curing said insulation resin.

6. The method of manufacturing a chip inductor according to claim 4, wherein said first heating process is carried out at 130 °C, and said second heating process is carried out at 230 °C.

7. The method of manufacturing a chip inductor according to claim 5, wherein said heating and filling process is carried out at 130°C, and said second heating process is carried out at 230°C.

8. The method of manufacturing a chip inductor according to claim 1, wherein surfaces of said conductive layer formed on both end surfaces of said substrate are not in contact with an electrodeposition bath to maintain said surfaces free of deposition of said insulation resin.

9. The method of manufacturing a chip inductor according to claim 1, further including an electric-field controlling process in said electrodeposition method, wherein said electric-field

controlling process ceases application of an electric field before a thickness of said insulation resin coating said coil becomes greater than a thickness of said conductive layer formed on the outer periphery of said substrate.

10. The method of manufacturing a chip inductor according to claim 1, wherein said insulation resin is epoxy-based resin.

11. The method of manufacturing a chip inductor according to claim 1, wherein the step of forming an electrode further comprises forming said electrode on said conductive layer formed on the outer periphery of said substrate with said insulation resin in between.

12. The method of manufacturing a chip inductor according to claim 11, wherein the step of forming an electrode further comprises forming said electrode from an end surface of said substrate to at least a portion that faces said conductor with said insulation resin in between.

13. The method of manufacturing a chip inductor according to claim 11, wherein the step of forming an electrode further comprises forming said electrode in a manner to locate between an end surface of said substrate and said conductor that constitutes said coil.

14. The method of manufacturing a chip inductor according to claim 11, wherein the step of forming a conductive layer further comprises forming a conductive layer also on both end surfaces of said substrate, and the step of forming an electrode further comprises forming an electrode on said conductive layer formed on the end surface of said substrate.

15. The method of manufacturing a chip inductor according to claim 11, wherein the step of forming a conductive layer includes leaving portions free of conductive layer by not forming said conductive layer on both end surfaces of said substrate, and a process of leaving portions free of electrode by not forming said electrode on said end surfaces of said substrate.

16. The method of manufacturing a chip inductor according to claim 11, wherein the step of forming an electrode further comprises forming said electrode in a manner that a thickness of said electrode formed on the outer periphery of said substrate is smaller than a thickness of said insulation resin formed on the outer periphery of said substrate.

17. The method of manufacturing a chip inductor according to claim 11, wherein the step of forming an electrode comprises forming said electrode by coating conductive resin and curing said conductive resin.

18. The method of manufacturing a chip inductor according to claim 11, wherein the step of forming an electrode comprises forming said electrode by coating conductive resin, flattening a coated surface by pressing it against a flattening plate after said conductive resin is coated, and curing said conductive resin thereafter.

19. The method of manufacturing a chip inductor according to claim 11, wherein said electrode is formed in such a configuration that a length of said electrode located on the outer periphery of said substrate is larger than 1/6, but smaller than 1/2 of a dimension of said substrate, both said length and said dimension being taken along an axial direction of said coil.

20. The method of manufacturing a chip inductor according to claim 1, wherein said conductive layer is formed on both end surfaces of said substrate, and wherein the step of forming an electrode further comprises cutting a surface of said conductive layer formed on both end surfaces of said substrate.

21. The method of manufacturing a chip inductor according to claim 20, wherein in the step of forming an electrode, a cutting depth to cut the surface of said conductive layer formed on both end surfaces of said substrate is set to an extent not to expose both end surfaces of said substrate.

22. The method of manufacturing a chip inductor according to claim 20, wherein in the step of forming an electrode, the surface of said conductive layer formed on both end surfaces of said substrate is cut with a laser irradiation.

23. The method of manufacturing a chip inductor according to claim 22, wherein said laser irradiation is performed by scanning the surface of said conductive layer for a plurality of times.

24. The method of manufacturing a chip inductor according to claim 20, wherein in the step of forming an electrode, the surface of said conductive layer formed on both end surfaces of said substrate and the surface of said conductive layer formed on an end portion of said outer periphery of said substrate are cut with laser irradiation.

25. The method of manufacturing a chip inductor according to claim 24, wherein said laser irradiation is performed by scanning the surface of said conductive layer for a plurality of times.

26. The method of manufacturing a chip inductor according to claim 1, wherein the step of etching said coil comprises electrolytic etching with application of an electric field between said conductive layer on the surface of said substrate and the electrolytic solution.

27. The method of manufacturing a chip inductor according to claim 26, further comprising the step of forming an oxide film on the conductor of said coil on said substrate, after the step of etching said coil.

28. The method of manufacturing a chip inductor according to claim 26, wherein the electrolytic etching is carried out while said conductive layer is kept in contact with an electrode plate for application of electric field.

29. The method of manufacturing a chip inductor according to claim 26, wherein the electrolytic etching is carried out in a manner that said substrate having said conductive layer formed thereon is placed in an electrically conductive vessel, electric field is applied between said conductive layer and electrolytic solution through said vessel while said substrate is kept in contact with said vessel.

30. The method of manufacturing a chip inductor according to claim 26, wherein the electrolytic etching is carried out so that a thickness of said conductive layer becomes larger than a width of the conductor of said coil.

31. The method of manufacturing a chip inductor according to claim 1, wherein the step of etching said coil is a chemical etching process.

32. The method of manufacturing a chip inductor according to claim 1, wherein the step of etching said coil is a chemical etching process with ultrasonic vibration.

Please add the following new claims:

--33. A method for manufacturing a chip inductor comprising the steps of:

forming a conductive layer on a substrate;

electrodepositing insulating resin on said conductive layer; and

forming electrodes on said substrate.

34. The method of claim 33, wherein the electrodepositing step comprises the steps of:

placing said substrate into a resin bath; and

applying an electric field between said conductive layer and said resin bath.

35. The method of claim 33, further comprising the step of:

forming grooves in said conductive layer.

36. The method of claim 35, further comprising the steps of:

heating the insulating resin at a temperature below the curing temperature of said insulating resin so that the insulating resin flows into said grooves; and

after the heating step, again heating the insulating resin at a temperature above the curing temperature of said insulating resin so as to cure the insulating resin.--

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

MCDERMOTT, WILL & EMERY

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Date: April 30, 2002

APPENDIX

1. (Amended) A method of manufacturing a chip inductor comprising the steps of:

[a process of] forming a conductive layer on an outer periphery of a substrate made of insulating material;

[a coil portion forming process for] forming a coil by spirally cutting said conductive layer;

[an etching process for] etching said coil;

[an insulation resin coating process for] forming an outer coating by coating at least said coil on said substrate with insulation resin; and

[an electrode forming process for] forming an electrode at both ends of said coil[,] and [for] making an electric contact between said electrode and said conductive layer,

wherein [said insulation resin coating process includes an electrodeposition process for covering said coil with said insulation resin, using] the step of forming an outer coating includes the step of using an electrodeposition method to deposit said [electrodeposition] insulation resin at least on a surface of a conductor of said coil.

2. (Amended) The method of manufacturing a chip inductor according to claim 1, further comprising [a heating process for] the steps of heating and curing said insulation resin, after using said electrodeposition [process] method.

3. (Amended) The method of manufacturing a chip inductor according to claim 2, further comprising [a] the step of cleaning [process] prior to [said] the step of heating [process].

4. (Amended) The method of manufacturing a chip inductor according to claim 2, wherein [said] the step of heating [process] comprises a first heating process for heating said insulation resin at a temperature lower than a curing temperature of said insulation resin, and a second heating process for heating said insulation resin thereafter at a temperature higher than the curing temperature of said insulation resin.

5. (Amended) The method of manufacturing a chip inductor according to claim 2, wherein [said] the step of heating [process] comprises a heating and filling process for heating said insulation resin at a temperature lower than a curing temperature of said insulation resin for filling a groove in said coil portion with said insulation resin, and a second heating process for heating said insulation resin at a temperature higher than the curing temperature of said insulation resin for curing said insulation resin.

6. (Amended) The method of manufacturing a chip inductor according to claim 4, wherein said first heating process is carried out at 130 °C, and said second heating process is carried out at 230 °C.

7. (Amended) The method of manufacturing a chip inductor according to claim 5, wherein said heating and filling process is carried out at 130°C, and said second heating process is carried out at 230°C.

8. (Amended) The method of manufacturing a chip inductor according to claim 1, wherein surfaces of said conductive layer formed on both end surfaces of said substrate are not in contact

with an electrodeposition bath to maintain said surfaces free of deposition of said insulation resin.

9. (Amended) The method of manufacturing a chip inductor according to claim 1, further including an electric-field controlling process in said electrodeposition [process] method, wherein said electric-field controlling process ceases application of an electric field before a thickness of said insulation resin [covering] coating said coil becomes greater than a thickness of said conductive layer formed on the outer periphery of said substrate.

10. (Amended) The method of manufacturing a chip inductor according to claim 1, wherein said [electrodeposition] insulation resin is epoxy-based resin.

11. (Amended) The method of manufacturing a chip inductor according to claim 1 [further including in said electrode forming process, a process of] , wherein the step of forming an electrode further comprises forming said electrode on said conductive layer formed on the outer periphery of said substrate with said insulation resin in between.

12. (Amended) The method of manufacturing a chip inductor according to claim 11 [further including in said electrode forming process, a process of] , wherein the step of forming an electrode further comprises forming said electrode from an end surface of said substrate to at least a portion that faces said conductor with said insulation resin in between.

13. (Amended) The method of manufacturing a chip inductor according to claim 11 [further including in said electrode forming process, a process of] , wherein the step of forming an electrode further comprises forming said electrode in a manner to locate between an end surface of said substrate and said conductor that constitutes said coil.

14. (Amended) The method of manufacturing a chip inductor according to claim 11 [further including in said conductive layer forming process, a process] , wherein the step of forming a conductive layer further comprises forming a conductive layer also on both end surfaces of said substrate, and [a process of] the step of forming an electrode further comprises forming an electrode on said conductive layer formed on the end surface of said substrate.

15. (Amended) The method of manufacturing a chip inductor according to claim 11 [including in said conductive layer forming process, a process of] , wherein the step of forming a conductive layer includes leaving portions free of conductive layer by not forming said conductive layer on both end surfaces of said substrate, and a process of leaving portions free of electrode by not forming said electrode on said end surfaces of said substrate.

16. (Amended) The method of manufacturing a chip inductor according to claim 11 [further including in said electrode forming process, a process of] , wherein the step of forming an electrode further comprises forming said electrode in a manner that a thickness of said electrode formed on the outer periphery of said substrate is smaller than a thickness of said insulation resin formed on the outer periphery of said substrate.

17. (Amended) The method of manufacturing a chip inductor according to claim 11 [further including in said electrode forming process a process of] , wherein the step of forming an electrode comprises forming said electrode by coating conductive resin and curing said conductive resin.

18. (Amended) The method of manufacturing a chip inductor according to claim 11 [further including in said electrode forming process a process of] , wherein the step of forming an electrode comprises forming said electrode by coating conductive resin, flattening a coated surface by pressing it against a flattening plate after said conductive resin is coated, and curing said conductive resin thereafter.

19. (Amended) The method of manufacturing a chip inductor according to claim 11, wherein said electrode is formed [in said electrode forming process] in such a configuration that a length of said electrode located on the outer periphery of said substrate is larger than 1/6, but smaller than 1/2 of a dimension of said substrate, both said length and said dimension being taken along an axial direction of said coil.

20. (Amended) The method of manufacturing a chip inductor according to claim 1, wherein said conductive layer is formed on both end surfaces of said substrate, and [said method further includes in said electrode forming process a process of] wherein the step of forming an electrode further comprises cutting a surface of said conductive layer formed on [the] both end surfaces of said substrate.

21. (Amended) The method of manufacturing a chip inductor according to claim 20, wherein in [said] the step of forming an electrode [forming process], a cutting depth to cut the surface of said conductive layer formed on [the] both end surfaces of said substrate is set to an extent not to expose [the] both end surfaces of said substrate.

22. (Amended) The method of manufacturing a chip inductor according to claim 20, wherein in [said] the step of forming an electrode [forming process], the surface of said conductive layer formed on [the] both end surfaces of said substrate is cut with a laser irradiation.

23. (Amended) The method of manufacturing a chip inductor according to claim 22, wherein said laser irradiation is performed by scanning the surface of said conductive layer for a plurality of times.

24. (Amended) The method of manufacturing a chip inductor according to claim 20, wherein in [said] the step of forming an electrode [forming process], the surface of said conductive layer formed on [the] both end surfaces of said substrate and the surface of said conductive layer formed on an end portion of said outer periphery of said substrate are cut with laser irradiation.

25. (Amended) The method of manufacturing a chip inductor according to claim 24, wherein said laser irradiation is performed by scanning the surface of said conductive layer for a plurality of times.

26. (Amended) The method of manufacturing a chip inductor according to claim 1, wherein [said] the step of etching [process includes a process of] said coil comprises electrolytic etching with application of an electric field between said conductive layer on the surface of said substrate and the electrolytic solution.

27. (Amended) The method of manufacturing a chip inductor according to claim 26, further comprising [a process] the step of forming an oxide film on the conductor of said coil on said substrate, after [said] the step of etching [process] said coil.

28. (Amended) The method of manufacturing a chip inductor according to claim 26, wherein the electrolytic etching is carried out [in said etching process] while said conductive layer is kept in contact with an electrode plate for application of electric field.

29. (Amended) The method of manufacturing a chip inductor according to claim 26, wherein the electrolytic etching is carried out [in said etching process,] in a manner that said substrate having said conductive layer formed thereon is placed in an electrically conductive vessel, electric field is applied between said conductive layer and electrolytic solution through said vessel while said substrate is kept in contact with said vessel.

30. (Amended) The method of manufacturing a chip inductor according to claim 26, wherein the electrolytic etching is carried out [in said etching process] so that a thickness of said conductive layer becomes larger than a width of the conductor of said coil.

31. (Amended) The method of manufacturing a chip inductor according to claim 1, wherein [said] the step of etching [process] said coil is a chemical etching process.

32. (Amended) The method of manufacturing a chip inductor according to claim 1, wherein [said] the step of etching [process] said coil is a chemical etching process with ultrasonic vibration.

ABSTRACT

Method of manufacturing a chip inductor including the steps of, a conductive layer forming process for forming conductive layer 4 on an outer periphery 2 and end surfaces 3 of a substrate 1, a coil portion forming process for forming coil portion 7 having conductor 5 and groove 6 by cutting spirally the conductive layer 4, an etching process for etching the substrate 1 having the coil portion 7 formed thereon; an insulation resin coating process for forming outer coating 8 by coating a surface of the conductive layer 4 with insulation resin 13; and an electrode forming process for forming electrodes 9 at both ends of the coil portion 7, and for making electric contacts between electrodes 9 and the conductive layer 4. A chip inductor having a flattened mounting surface of the outer coating is obtained when insulation resin layer 8 is formed by an electrodeposition method in the insulation resin coating process. The chip inductor can be securely mounted to a circuit board.

Docket No.: 43890-555 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	
	:	
Toyonori KANETAKA, et al.	:	
	:	
Serial No.: 10/009,750	:	Group Art Unit:
	:	
Filed: December 12, 2001	:	Examiner:
	:	

For: METHOD OF MANUFACTURING CHIP INDUCTOR

REQUEST FOR APPROVAL OF DRAWING AMENDMENT

Commissioner for Patents
Washington, DC 20231

Sir:

Approval of the changes made to Figures 18-20, as shown in red ink on the attached photocopies, is courteously solicited.

Respectfully submitted,

MCDERMOTT, WILL & EMERY

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Date: April 30, 2002

FIG. 18 Prior Art

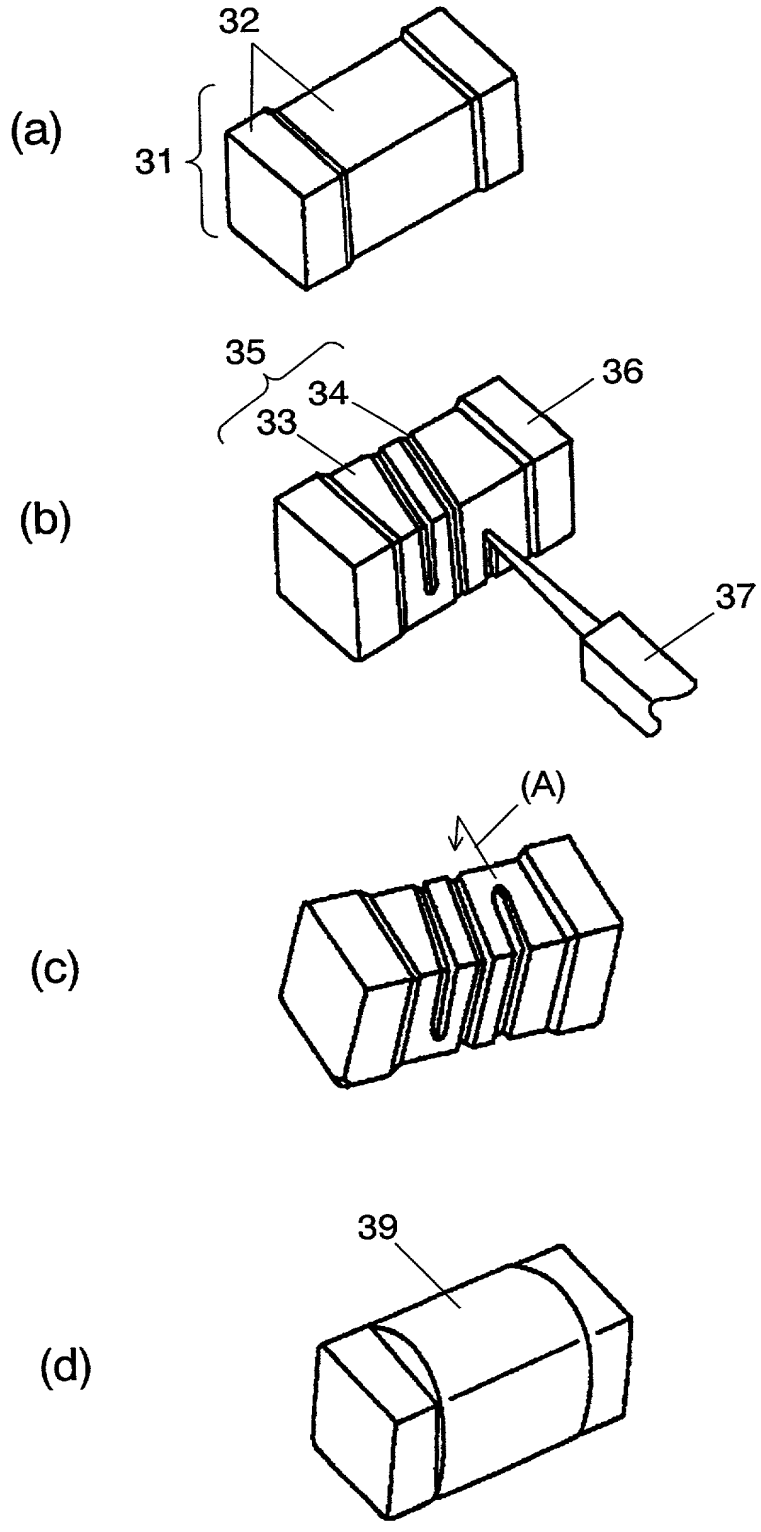

FIG. 19 Prior Art

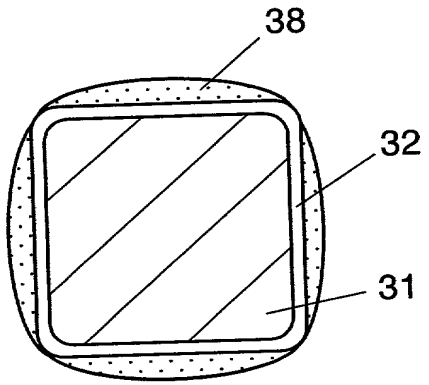

FIG. 20 Prior Art

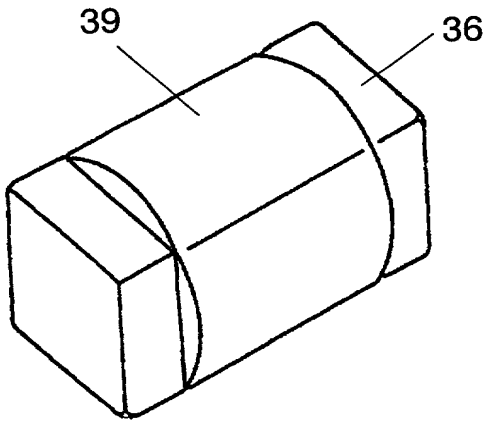

FIG. 18 Prior Art

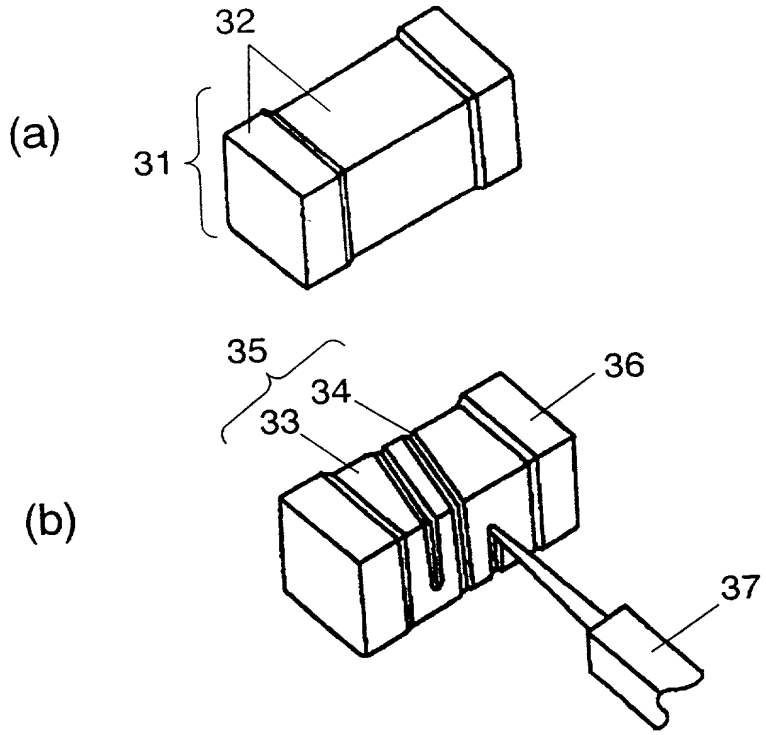

FIG. 19 Prior Art

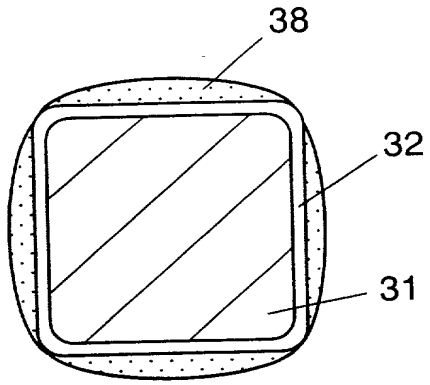

FIG. 20 Prior Art